

ODUS

Ozone Dynamics Ultraviolet Spectrometer

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ODUS System Overview

- NASDA activities about UV ozone sensors
- Overview of Science
 - Scientific Objectives
 - Characteristics
- Overview of instrument

NASDA activities about UV ozone sensors

- 1993 Feasibility studies focused on UV array detectors for satelliteborne spectrometer have been finished
- 1994 Preliminary system studies of UV Ozone spectrometers including ODUS have been finished
- 1996 ODUS system design has been started and trial productions of critical components are now in preparation

Scientific objectives

- Global mapping of ozone
 - total ozone
 - stratospheric and tropospheric ozone
- Detection of volcanic SO₂
 - total SO₂ and vertical profile
 - boundary layer SO₂
- Experimental detection of NO₂
- Aerosol and cloud top height measurement

ODUS characteristics

- Simultaneous spectrum measurement with high resolution of 0.5 nm by array detector improves ozone measurement precision
- High horizontal resolution of 20 km makes possible to observe lower stratospheric dynamics

ODUS characteristics -- continued

- Wide wavelength coverage to 420 nm makes possible to detect atmospheric NO₂, cloud height, and optical properties of aerosols

Base line specification for system design -- tentative

	Base line for system study	TOMS (reference)
Detector	1D Si PD array detector	PMT
Wave length	306—420 nm	308—360 nm
Band width	0.5 nm	1 nm
Sensitivity of polarization	< 3 %	< 5 %
Number of bands	228 continuous	6
S/N	TBD	> 30 at 308 nm
IFOV	20 km (1.6 deg)	44 km (3 deg)
Swath width	120 deg	120 deg
Calibration	Hg lamps & diffusers	Hg lamps & diffusers
Integration time	30 msec	5 msec
Data Rate	100 Kbps	736 bps
Weight	<40 kg	30 kg
Power	<65 W (peak), <50 W(average)	14 W (average)
Size	300mm X 500mm X 500mm	

Weight estimate

In the case of IFOV=20 km

Monochrometer Optics	4.1 kg
Foreoptics	5.0 kg
Scanning system electronics	2.75 kg
Calibration system	2.5 kg
Optical module subtotal	14.35 kg
Electronics module & housing subtotal	< 25 kg
Total	< 40 kg

Consumption power estimate

In the case of IFOV=20 km

• @• @ Scan motor driver	5 W (average)
Heater	10 W (average)
Detector electronics	5 W (average)
Calibration lamps	3 W (peak)
Diffuser motor	10 W (peak), 0.1 W (average)
Optical module subtotal	33 W (peak), 20.1 W (average)
Electronics module subtotal	< 30 W (average)
Total	< 65 W (peak), < 50 W (average)

Detector specification

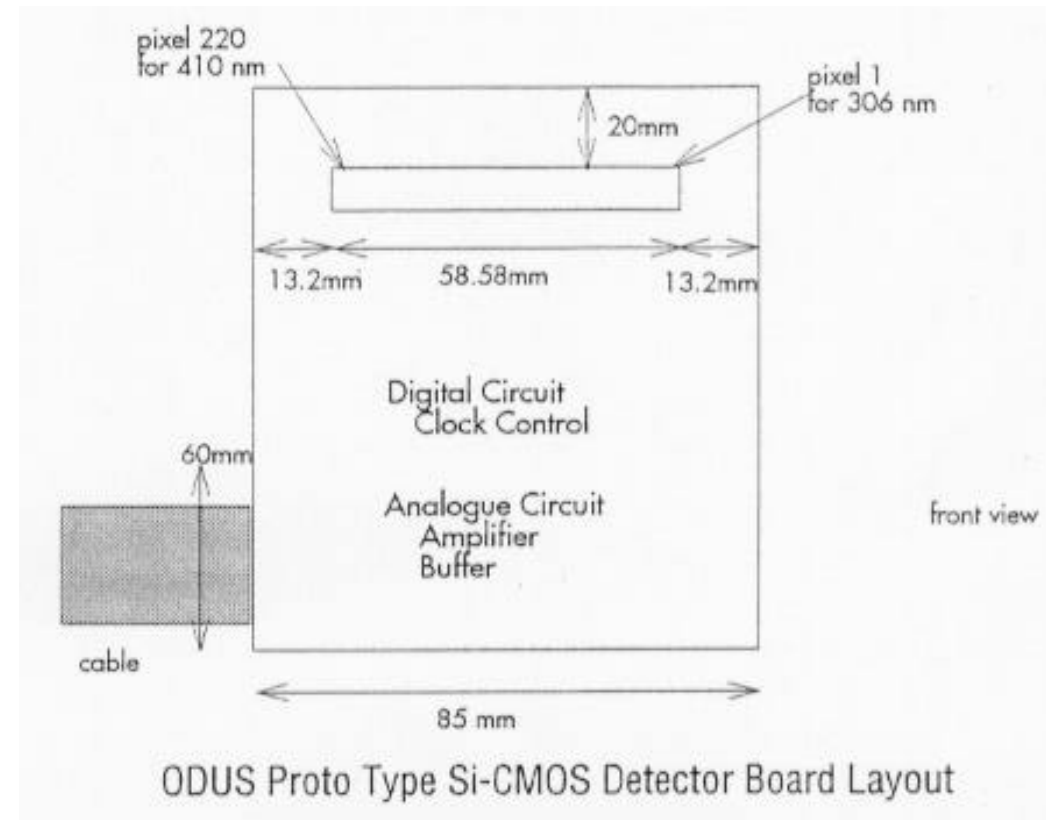
for trial production -- tentative

Detector type	1 dimensional Si photo diode array
Wavelength range	306 – 420 nm
Size of pixel	0.26 X 0.26 mm
Number of pixels	1 X 228 + dummy pixels for dark current monitor
Integration time	30 ms (simultaneous integration)
Quantum efficiency	> 35 % (target, priority 306 – 335 nm)
Operating temperature	between -25 and 50 • Žon orbit
Life	5 years
Read out	CMOS correlated double sampling on chip
Preamplifier	differential amp on chip to reduce dark current

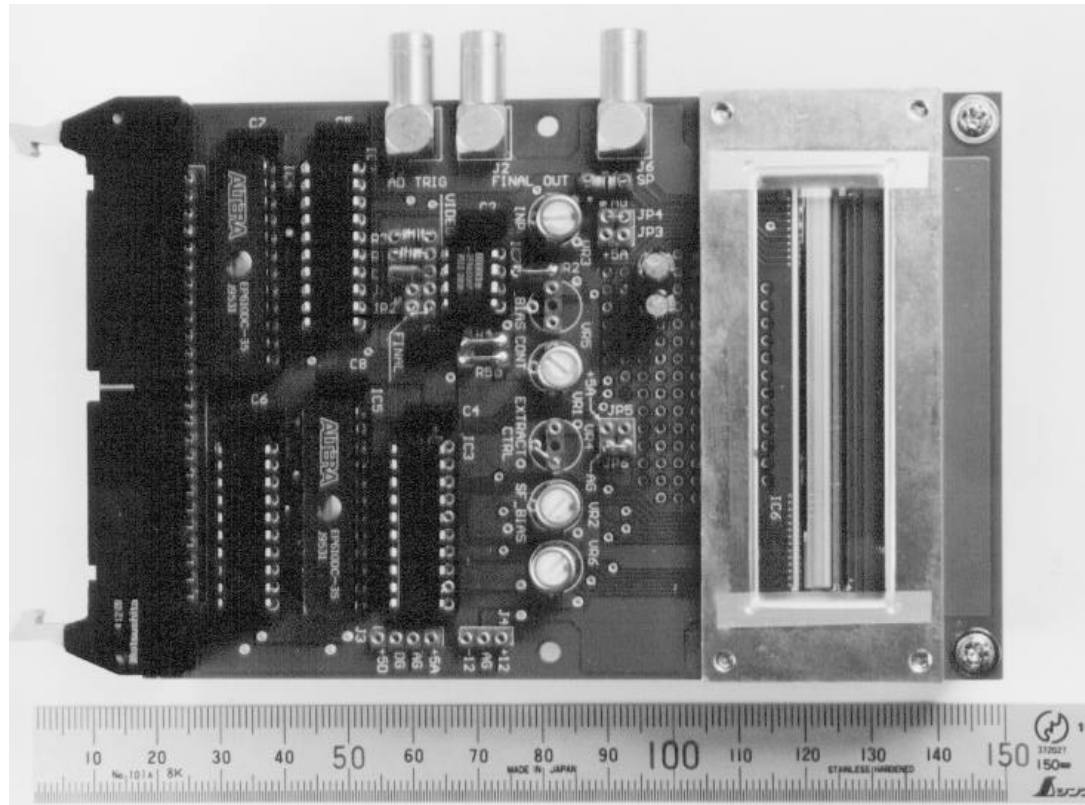
Proto-type linear array detector

- Si-CMOS linear array detector
- Low level dark current
- UV sensitive

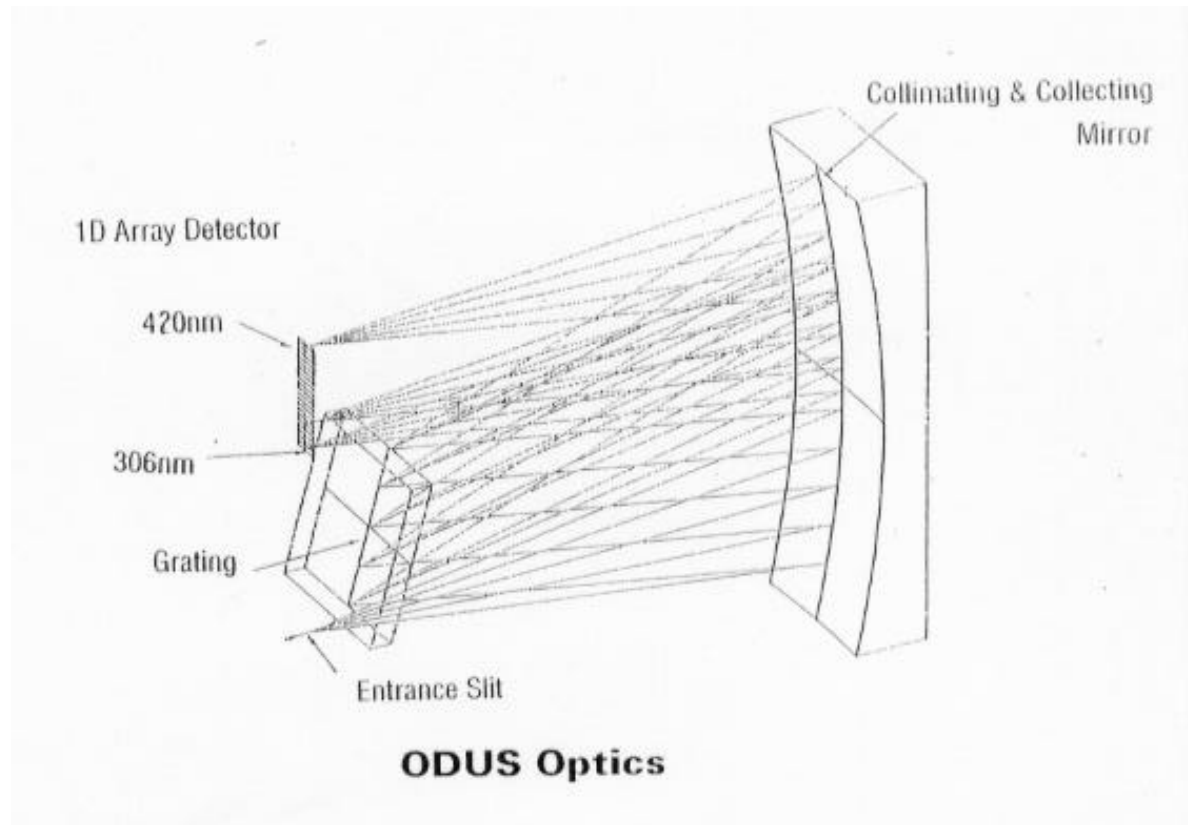
Si-CMOS detector board using of proto-type detector



Proto-type Si-CMOS detector board



Conceptual figure of optical system

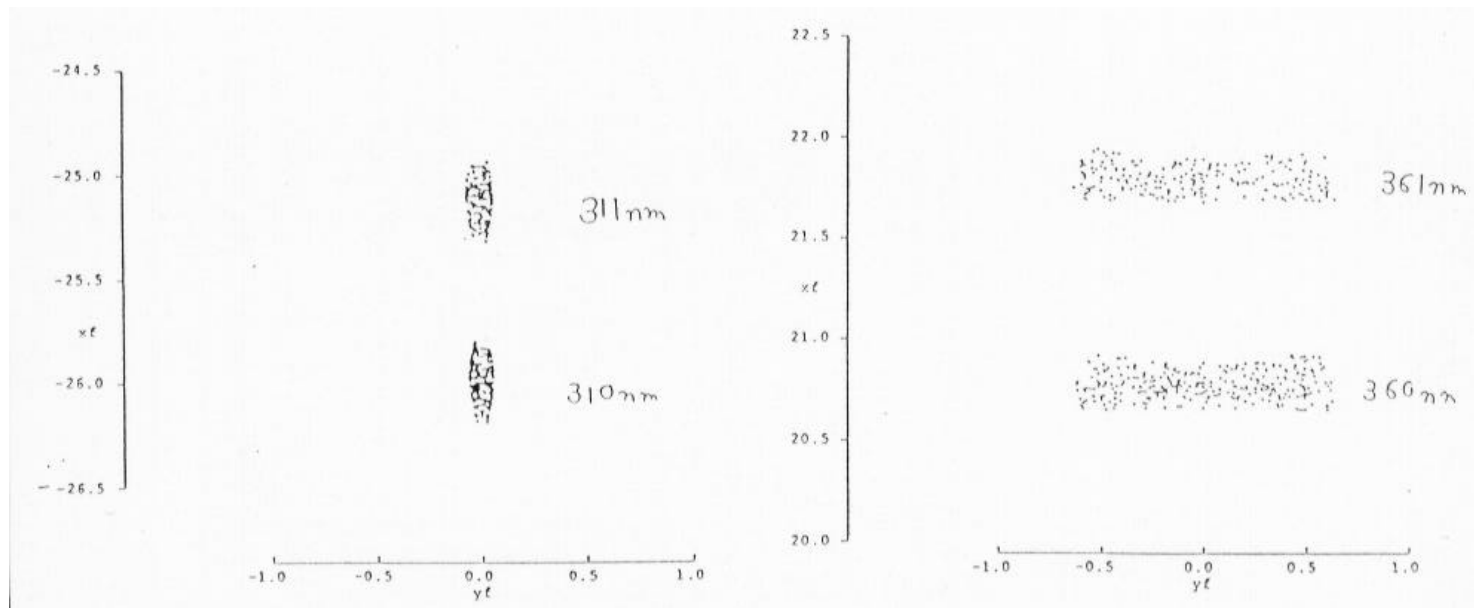


Optical parameter analysis

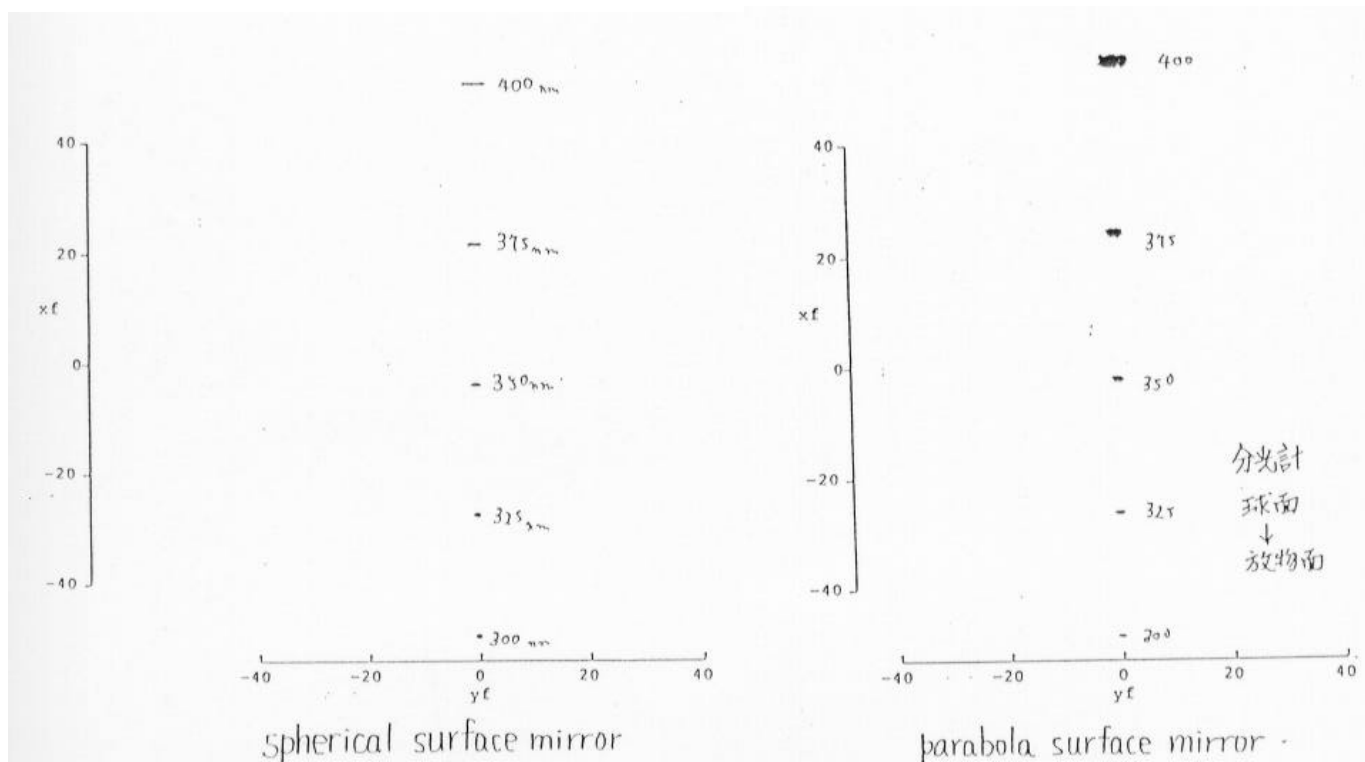
F number	5.2	3.5	2.6
Number of grooves	1900 per mm	1667 per mm	1667 per mm
Grating tilt angle	17 deg	15.5 deg	15.5 deg
Grating aperture	52 mm	70 mm	80 mm
Entrance slit off-axis distance	32 mm	47 mm	60 mm
Focal plane length	57 mm	47.8 mm	49.4 mm
Slit width	0.24 mm	0.208 mm	0.208 mm
Entrance aperture	1.83 mm	2.37 mm	3.19 mm

These parameters are selected in order that focal plane length is moderate like 50 mm

Ray tracing simulation



Ray tracing simulation



Scanning system trade off

	1D Array detector Whiskbroom	2D array detector +Mechanical Scanning Whiskbroom	2D Array detector
Summary	1D Spectral scan	1D Spectral scan 1D Along track scan	1D Spectral scan 1D Cross track scan no mechanical scan
Pixels	228	228*12	228*80
Power	Medium	Medium	Low
Reliability	Medium	Medium	High
Optical performance	good	Slit Aberration	Wide field lens needed
Integration time	30 msec	400 msec	3 sec
Detector effective area	> 90 %	75 %	75 %
Solar diffuser	OK	OK	Difficult
Life	Depend on Scanner	Depend on scanner	Long
Total estimate	OK	OK	Difficult

Baseline is whiskbroom scanning(1D).

Counter measures to stray light

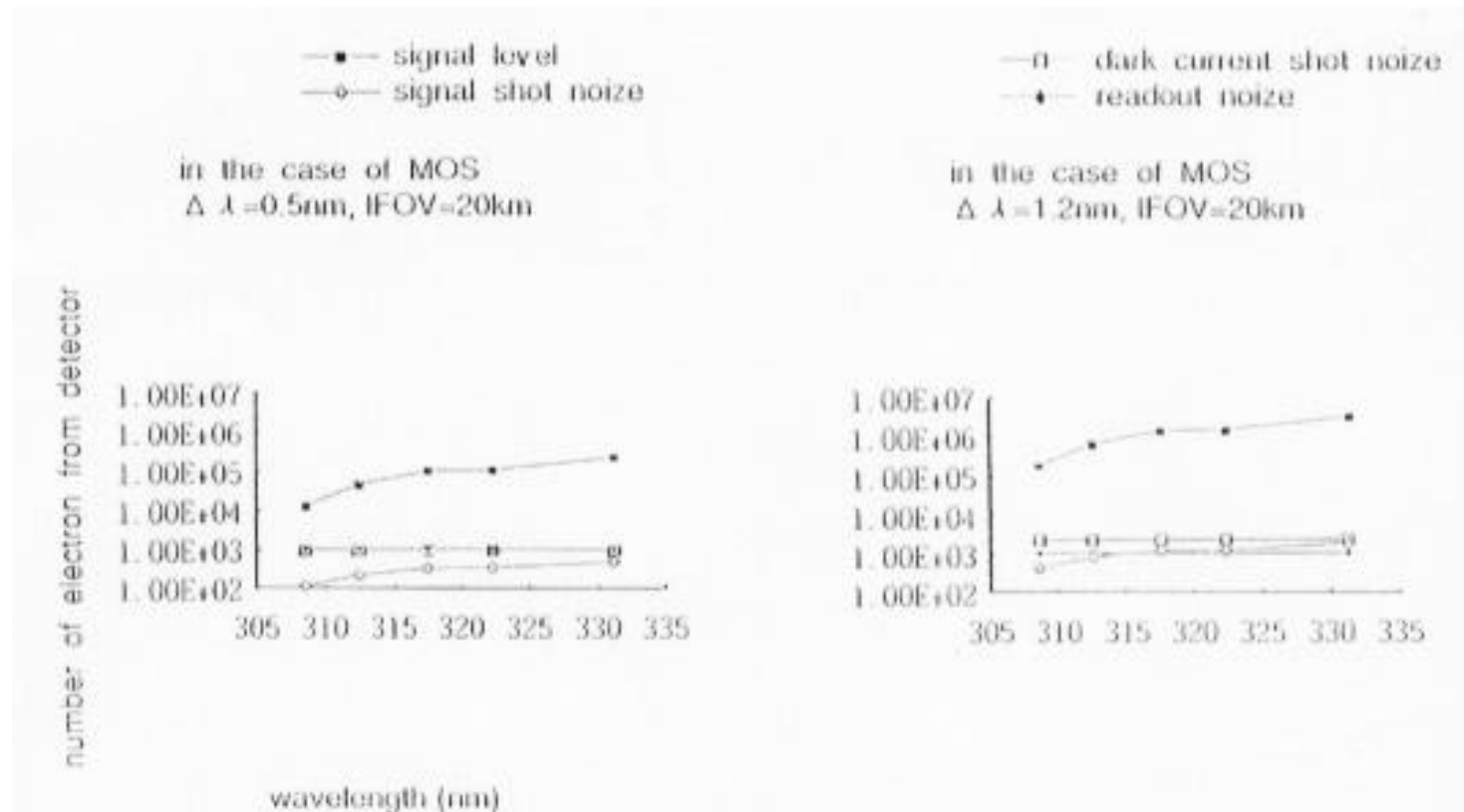
■ Causes of stray light

- Diffracted light except 1st order
- Overflow from grating
- Scattered light from optical parts and housing wall

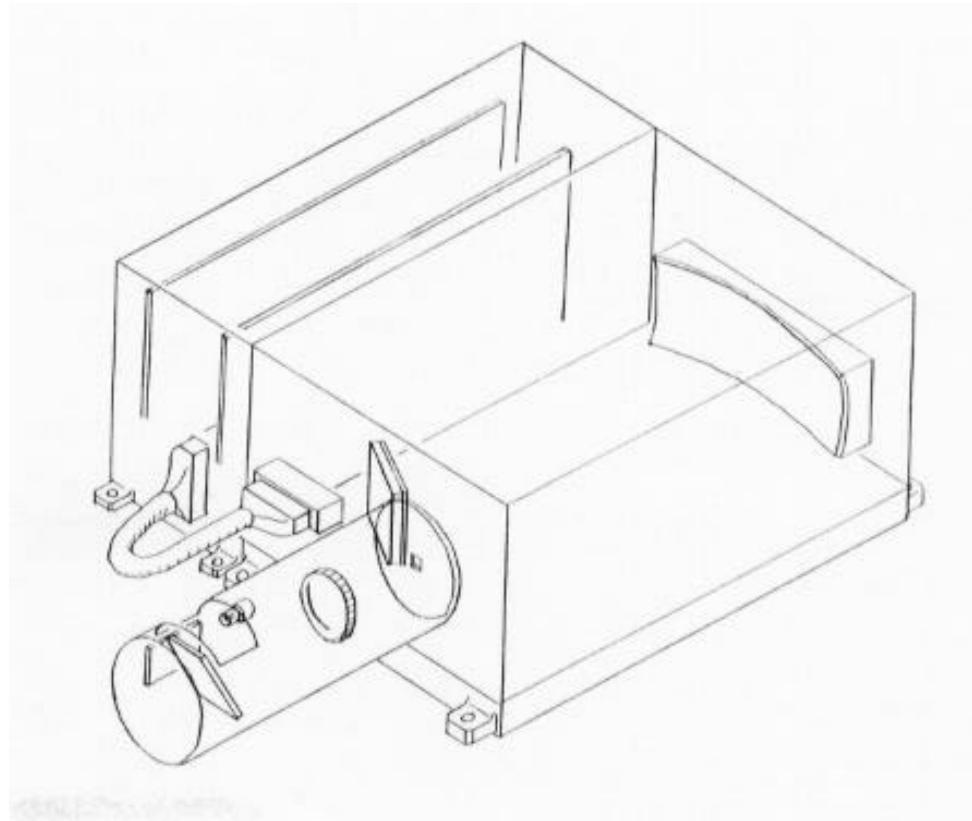
■ Counter measures

- Suppression of reflection and scattering
- Absorption of 0 order diffracted
- Narrow entrance light flux

S/N analysis (preliminary)



Conceptual configuration



Schedule

